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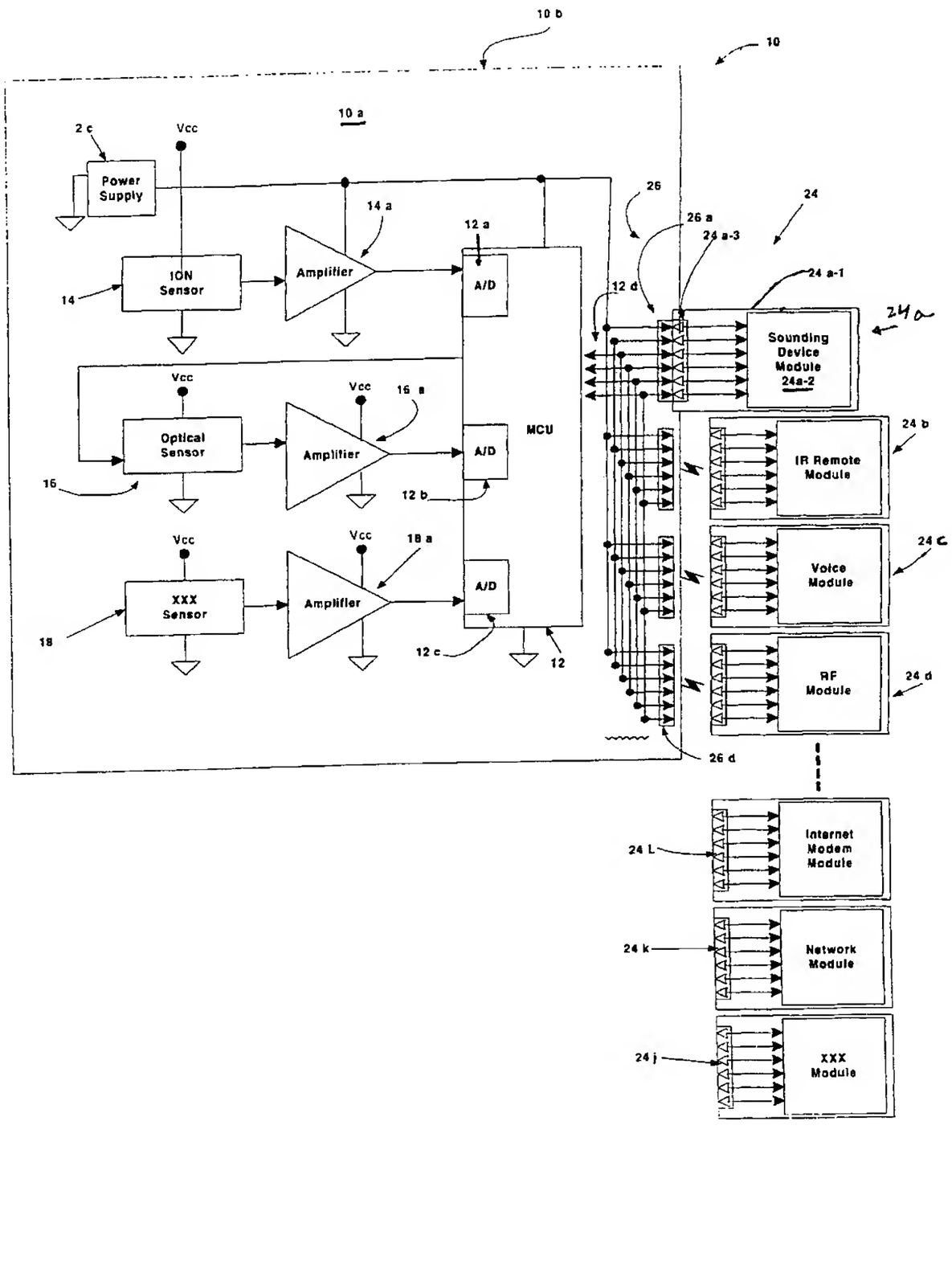
(54) Title: MODULAR DETECTOR SYSTEM



(57) Abstract: A modular detector includes at least one module receiving port. Members of a plurality of modules have a common form factor and are removably insertable into the port. Members of the plurality, when inserted, implement a selected communication, sensing or output function. One module can be removed and replaced with another thereby changing detector characteristics. A respective detector could have several ports to receive a plurality of insertable modules.

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MODULAR DETECTOR SYSTEM

Field of the Invention:

The invention pertains to ambient condition detectors. More particularly, the invention pertains to such detectors which facilitate user flexibility in defining over-all function characteristics.

Background of the Invention:

Smoke detectors have become commonly used in residential applications. Many residences incorporate a plurality of such detectors either operating in a stand-alone fashion or interconnected in some way.

Known detectors are manufactured in large quantities using automated manufacturing equipment, and, as a result, have become very cost effective in inexpensive consumer products. Automated manufacturing processes provide maximum economic benefit where large numbers of identical products can be manufactured. While beneficial from a cost perspective, large volume manufacturing produces products having a common set of functional parameters with little or no opportunity to vary those parameters subsequent to production.

There are times where it might be desirable to be able to vary the parameters of a detector. For example, while fire detectors very often incorporate smoke sensors, it might be desirable to also incorporate a temperature or a humidity sensor in some installations but not all. Additionally, it might be desirable to be able to provide a voice messaging output function for some installations but not others.

There are thus continues to be a need to be able to manufacture detectors which exhibit a greater degree of functional variability than heretofore has been available in volume. Preferably, such flexibility could be provided without significantly increasing manufacturing costs or detector complexity.

Summary of the Invention:

A detector system includes a common mechanical/electrical, section and a plurality of electrical interchangeable modules. The modules have a common

physical form factor and a common electrical interface. Different modules provide different functions implemented at least in part by respective circuitry carried therein.

The common section can be combined with a user selected set of modules prior to installation. The user can alter the module mix after installation.

In one embodiment, a single station smoke detector has the ability to receive various plug-in modules at the consumer's discretion. In one aspect, a smoke alarm has the flexibility of add-on functions such as RF (radio-frequency), remote testing and monitoring, voice alarm, I-chip for internet protocol and a modem. These functions can be selectively provided using a plurality of plug-in modules having a standardized interface and form factor. This invention provides the consumer with a myriad of different functional choices. In one embodiment, a microprocessor uses each plug-in module's function and performance to provide a customized, user alterable, detector.

The detector can incorporate fire/smoke sensors, gas, chemical, humidity, temperature sensors and other sensors. These can be permanently installed or addable using modules. Other types of interfaces or outputs can be provided using modules.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the embodiments thereof, from the claims and from the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 is an over-all block diagram of a system in accordance with the present invention;

Fig. 2 is a perspective view of an embodiment of a system in accordance with the present invention;

Fig. 3 is an exploded view of the system of Fig. 2;

Fig. 4 is a perspective view of an alternative embodiment of the present invention;

Fig. 5 is an exploded view of the embodiment of Fig. 4;

Fig. 6 is a perspective view of yet another embodiment of the present invention; and

Fig. 7 is an exploded view of the embodiment of Fig. 6.

Detailed Description of the Preferred Embodiments:

While this invention is susceptible of embodiment in many different forms, there are shown in the drawing and will be described herein in detail specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Fig. 1 illustrates a modular system 10 in accordance with the present invention. System 10 incorporates a support element 10a which could be implemented for example as one or more printed circuit boards. Support element 10a as would be understood by those of skill in the art would be carried by a housing generally indicated at 10b.

In the exemplary embodiment of Fig. 1, control circuitry 12, implemented using a programmed processor is carried on the board or element 10a. The control circuitry 12 includes a plurality of analog input ports 12a, b, c which are coupled to internal analog/digital converters. A plurality of bidirectional digital ports 12d provide four or eight bit binary bidirectional communication.

System 10 can incorporate a plurality of ambient condition sensors such as smoke sensors 14, 16 illustrated as exemplary ionization-type and photoelectric-type smoke sensors. Detector 10 can also incorporate other sensors generally indicated at 18.

Outputs from the respective sensors 14-18 can be coupled through interface circuitry 14a, 16a and 18a to the analog inputs of control circuitry 12 as would be understood by those of skill in the art.

System 10 incorporates, for example, a plurality of modules 24 which are removably couplable via a plurality of connectors 26, carried on support element 10a, to control circuitry 12. It will be understood that while connectors 26 are illustrated coupled to the binary input/output ports 12d of control circuitry 12, that

if other forms of control circuitry such as hardwired elements are used, corresponding connections would be made to connectors 26.

Each of the modules of the plurality 24, such as modules 24a, b ... l provides circuitry for implementing a function not present in essentially permanent form in system 10. Rather, by selecting among the available modules, it is possible to customize the functional characteristics of respective ones of systems 10 to provide differing functions. For example, if the infrared remote module 24b is selected, it will be possible to remotely conduct tests of the specific form of the system 10 using a displaced infrared source, to silence nuisance alarms and the like. Alternately, if voice module 24c is selected, a speech output can be provided in addition to any alarm indicating tones which might be provided either by an audible output device permanently coupled to control circuits 12 or one carried by module 24a.

Each of the modules exhibits a standardized form factor, illustrated by representative housing 24a-1. Carried within the housing is respective circuitry such as 24a-2 which provides the desired functionality of the respective module. Circuitry 24a-2 is coupled via connector element 24a-3 to control circuitry 12 where the respective module is plugged into or engaged with respective connector 26, such as connector 26a.

Since the illustrative system 10 incorporates four system connectors 24a, b, c, d, four different functional modules can be selected and incorporated thereinto. It will be understood that not all four modules need be selected for every installation. More modules can be provided if desired.

The present invention provides great flexibility to a user whereby representative detector 10 can be installed at a user's premises, such as the user's house, and the selected module combination can be varied by the user both before or after installation to provide a customized detector system for that particular installation.

It will be understood that the number of connectors 26 is exemplary only and is not a limitation of the present invention. Similarly, the functionality of

exemplary modules 24 is also merely exemplary and is not a limitation of the present invention.

Various configurations of housings, such as the housing 10b and selected modules 24 are discussed subsequently. It will be understood that various modular detector systems 10-1, -2, -3 which are discussed subsequently are merely exemplary and other variations are possible and come within the spirit and scope of the present invention.

It will also be understood by those of skill in the art that the use of standardized modules as disclosed herein makes it possible to not only obtain the benefit of economics of scale from automated manufacturing of standardized products, such as the system 10, exclusive of the modules, but also to retain the benefits of flexibility. The modules 24 provide user flexibility of a type heretofore not available in residential ambient condition detectors.

Figs. 2 and 3 illustrate various views of a detector system 10-1 wherein the modules can be inserted into an exposed, user-accessible, surface of the housing 10b-1. With respect to Figs. 2 and 3, housing 10b-1 is formed with a cover 30 which has a rotatable door 30a attached thereto. The cover 30 is in turn attached to base 30b which has an exterior mounting surface 32 which is intended to be located adjacent to a mounting surface S such as a ceiling via a mounting bracket 33. When so-mounted, the pivotable door 30a extends away from the ceiling and is accessible to a user.

The system 10a-1 incorporates printed circuit boards or mounting elements 10a-1 and 10a-2 corresponding to element 10a of Fig. 1.

As illustrated in Fig. 3, control circuitry 12 can be carried, for example, on mounting element 10a-2 along with other electronic circuitry and if desired, a permanently mounted audible output device 19. The device 19 could for example be capable of generating a plurality of alarm indicating output tones as would be known to those of skill in the art.

When the cover 30a has been rotated to an open position, the user is provided access to a plurality of ports 30-1, -2 and -3 in surface 30c of cover 30. The ports 30-1, -2 and -3 provide mechanical access for selected modules from the

plurality 24, such as modules 24b, c, and i to be inserted into the cover 30 and to removably engage control element 12 via connectors such as connectors 26 and 24i-3.

Insertion of the indicated modules into the ports 30-1, 30-2 and 30-3 provides an easy and convenient way for a user to provide selected additional functions in the respective systems 10-1 not present in the common base portion thereof. The functionality can be revised and altered during the life of the system10a-1 by changing the mix of inserted modules 24.

Figs. 4 and 5 illustrate an alternate configuration, system 10-2. In system 10-2, cover 40 encloses a rotating access door 40a. Both cover 40 and access door 40a are slotted for a plurality of module receiving slots 40-1, 40-2, 40-3 and 40-4.

In the configuration of Figs. 4 and 5, a plurality of modules, such as modules 24b, 24c, 24i and 24k extend laterally relative to a central axis of cover 40 through ports 40-1 .. -4 in cover 40 and rotating access door 40a. When so inserted, the respective modules slideably engage control circuitry 12 via connectors such as connectors 24b-3, 24c-3, 24i-3, 24k-3 and connectors 26.

It will be understood that less than four modules can be used with the system 10-3 without departing from the spirit and scope of the present invention. In such an instance, detector system 10-3 would simply provide fewer selected functions than in an instance where a larger number of modules was being used.

Figs. 6 and 7 illustrate yet another configuration in a system 10-3. In the system 10-3, ports 50-1 ... 50-n are provided in cover and base sections 50, 50b. The ports 50-1 .. 50n provide user access for a selected number of modules from the plurality 24 which can be removably inserted through the respective port to engage control circuitry 12. Additionally, in the event that fewer modules are selected than there are available ports, a plurality of missing module plugs 54 can be used as inserts to fill in unused ports 50-i for aesthetic purposes and to keep dust and other debris from the interior of the housing 50.

It will be understood that a variety of additional features can be incorporated into the respective detector systems without departing from the spirit and scope of the present invention. Representative additional types of features include test

activation switches or buttons such as button 60, or, display 62 which can be incorporated into respective housings, such as the housing 50, to provide alpha numeric readouts such as concentration status and the like. It will be understood that such features while convenient and desirable at times are selectable and provideable without departing from the spirit and scope of the present invention. They can also be provided via one or more plug-in modules.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

What is Claimed:

1. A detector comprising:

a housing;

at least one ambient condition sensor carried by the housing; and

a plurality of plug-in modules wherein the modules each exhibit a common, predetermined, form factor and wherein each provides a different function when plugged in.

2. A detector as in claim 1 which includes control circuitry coupled between the sensor and a plugged in module.

3. A detector as in claim 2 which includes interface circuitry coupled between the control circuitry and the plugged-in module.

4. A detector as in claim 3 wherein the members of the plurality each include common coupling circuitry for communicating with the interface circuitry when the respective module is plugged-in.

5. A detector as in claim 3 which includes a programmed processor.

6. A detector as in claim 5 which includes pre-stored executable instructions for evaluating sensor outputs and making an alarm determination.

7. A detector as in claim 1 wherein some members of the plurality provide interface functions and others provide sensing functions.

8. A detector as in claim 4 wherein the members of the plurality are selected from a class which includes at least an interfacing function, a sensing function, an output function, a display function; a test function and a silence function.

9. A detector as in claim 8 wherein the housing includes at least one module receiving port.

10. A detector comprising:

a housing with openings for ingress and egress of ambient air and a module receiving opening;

at least one ambient condition sensor carried within the housing;

an audible output device carried in the housing;

control circuitry coupled to the sensor and the output device;

an interface member carried within the housing; and

at least one module removably insertable into the housing and engageable with the interface member wherein the module electrically engages the control circuitry and in combination therewith provides at least one additional function not provided by the control circuitry above.

11. A detector as in claim 10 which includes a plurality of modules wherein each module is insertable into the module receiving opening, and thereby couplable to the control circuitry and wherein the modules provide a function selected from a class which includes a sensing function; a communicating function, a human discernable output function, a test initiating function and a silencing function.

12. A detector as in claim 10 wherein the housing includes a mounting surface positionable against a selected surface whereby the module continues to be accessible for user removal or replacement.

13. A detector as in claim 10 wherein the module is moved one of axially and laterally relative to an axis of the housing while being inserted.

14. A detector as in claim 10 which includes a movable member for covering the openings at least when the respective module is not being inserted.

15. A plurality of modules, insertable into a common ambient condition detector portion, the modules each comprising:

a housing having a predetermined form factor;

a plurality of connector elements carried by the housing;

electrical circuitry carried in the housing which, when engaged with the detector portion, interacts with control circuitry carried in the ambient condition detector portion to provide at least one additional function not present therein.

16. A plurality as in claim 15 wherein the respective electrical circuitry implements a function selected from a class which includes ambient condition sensing functions, monitoring functions, interface functions, and communications functions.

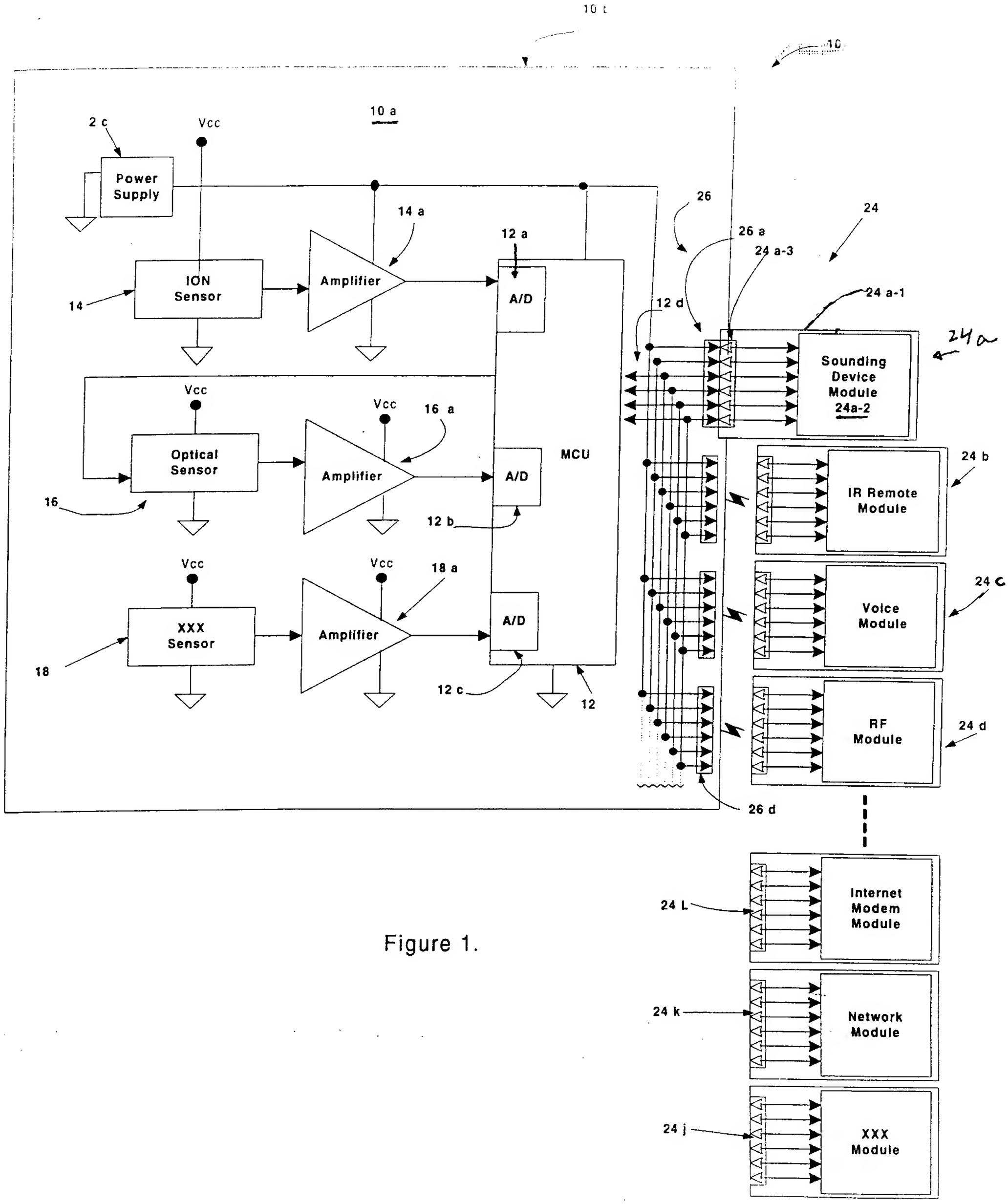
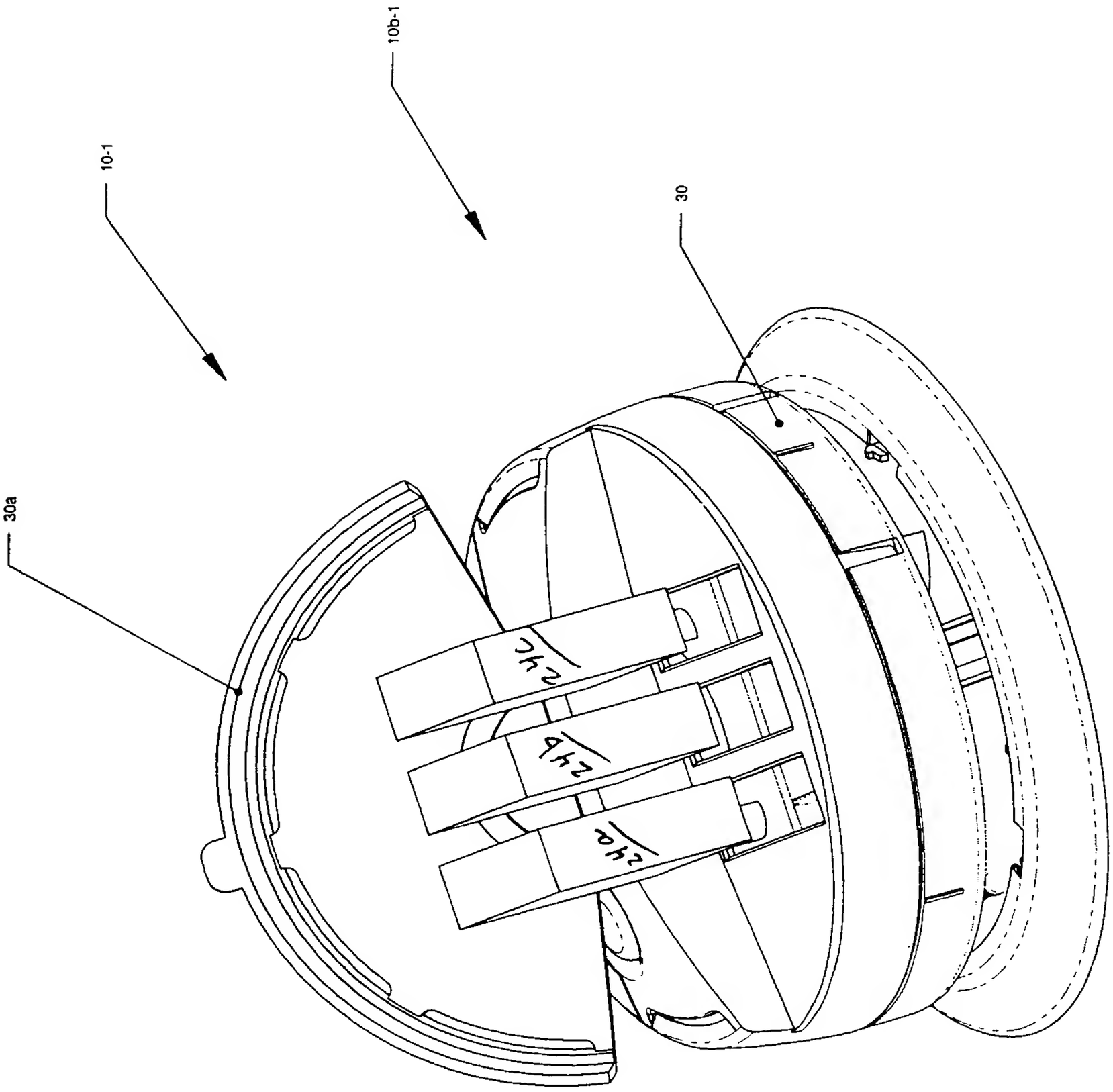

10 t
10
10 a
2 c
Vcc
Power Supply
14 a
12 a
26
24
26 a
24 a-3
24 a-1
14
ION Sensor
Amplifier
A/D
12 d
24a
Sounding Device Module 24a-2
Vcc
Vcc
16 a
Optical Sensor
Amplifier
A/D
MCU
16
12 b
24 b
IR Remote Module
Vcc
Vcc
18 a
XXX Sensor
Amplifier
A/D
24 c
Voice Module
18
12 c
12
RF Module
24 d
26 d
Internet Modem Module
24 L
Network Module
24 k
XXX Module
24 j

Figure 1.



TOP ACCESS - VERTICAL ORIENTATION
FIG. 2

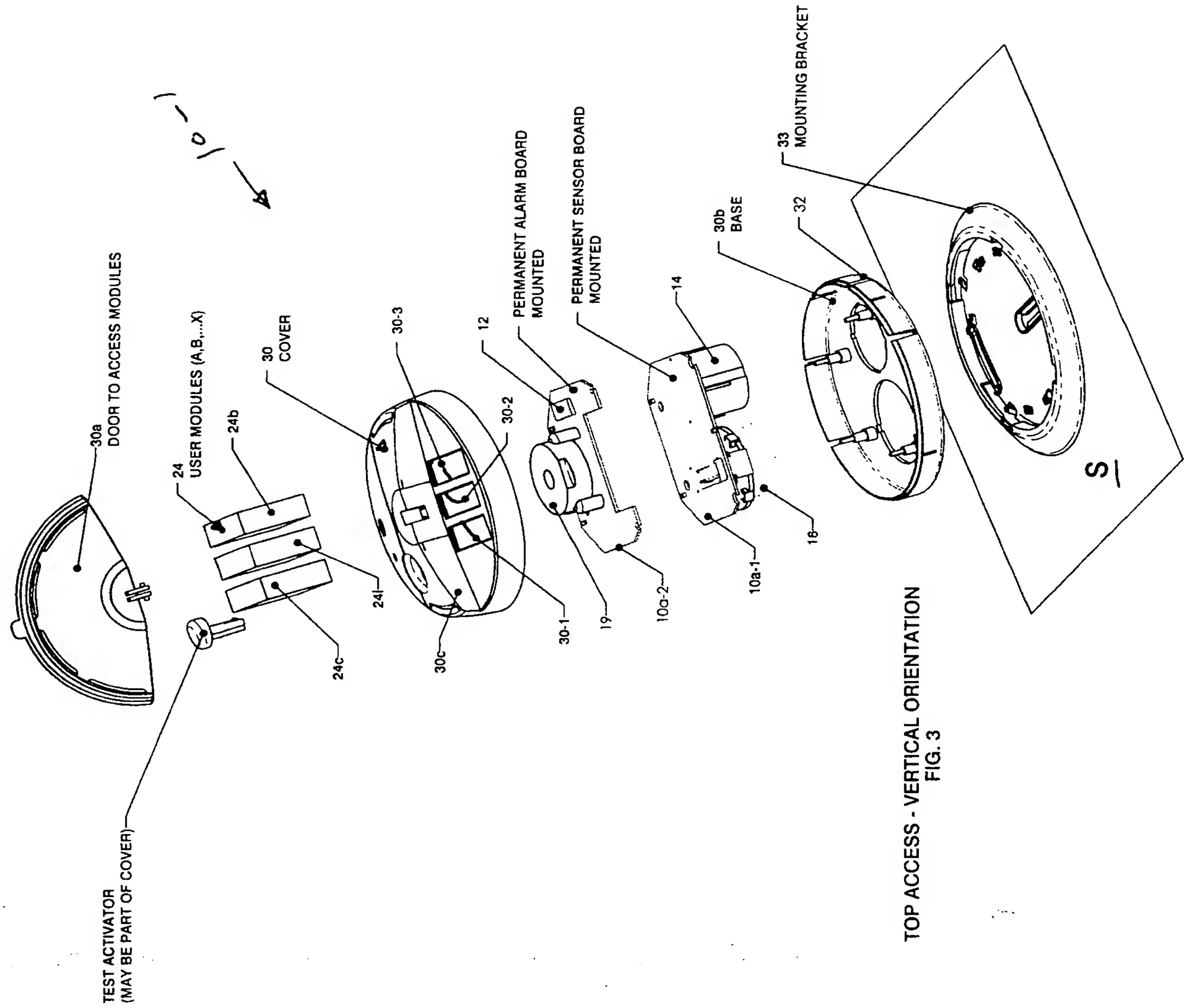
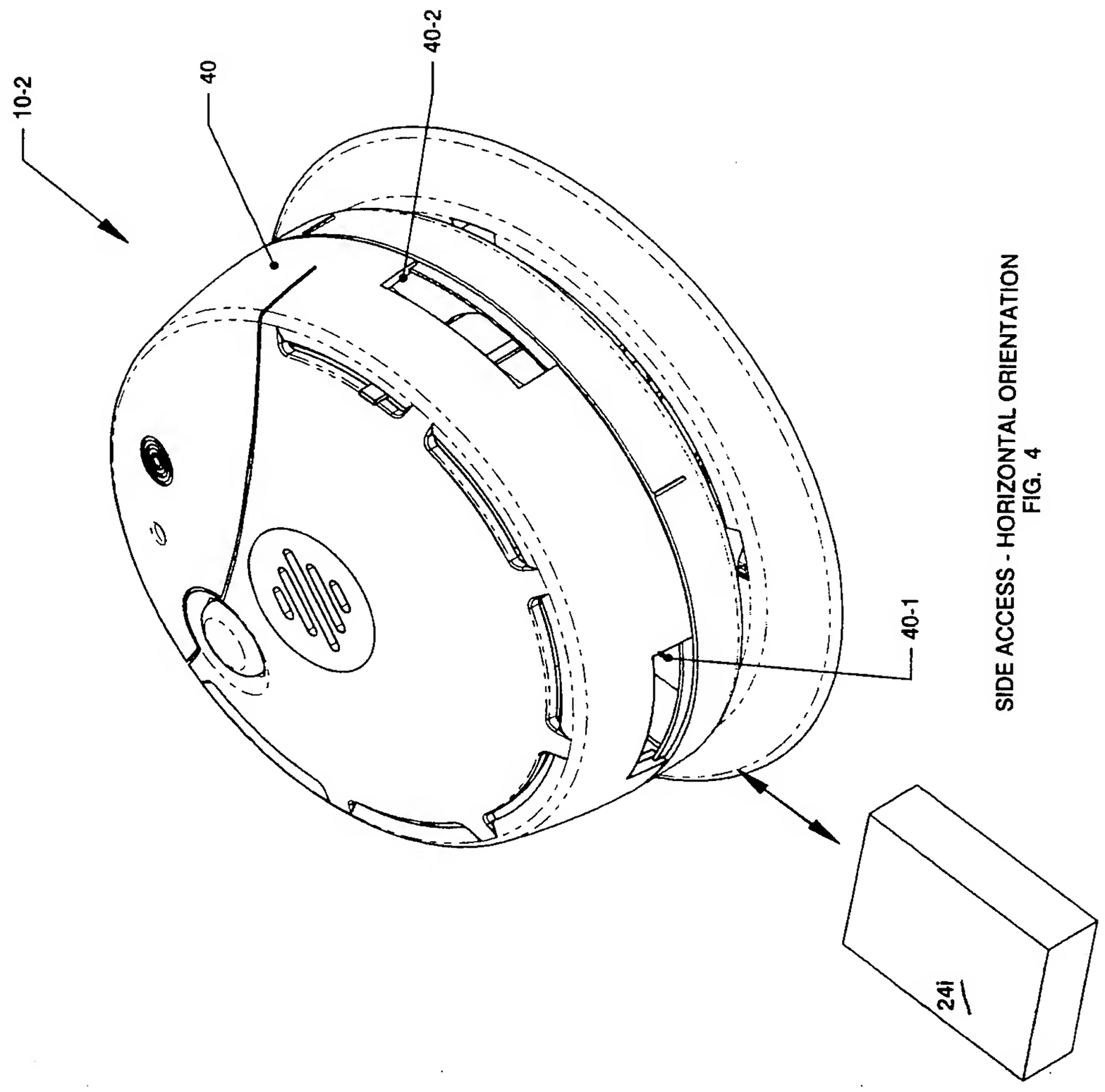
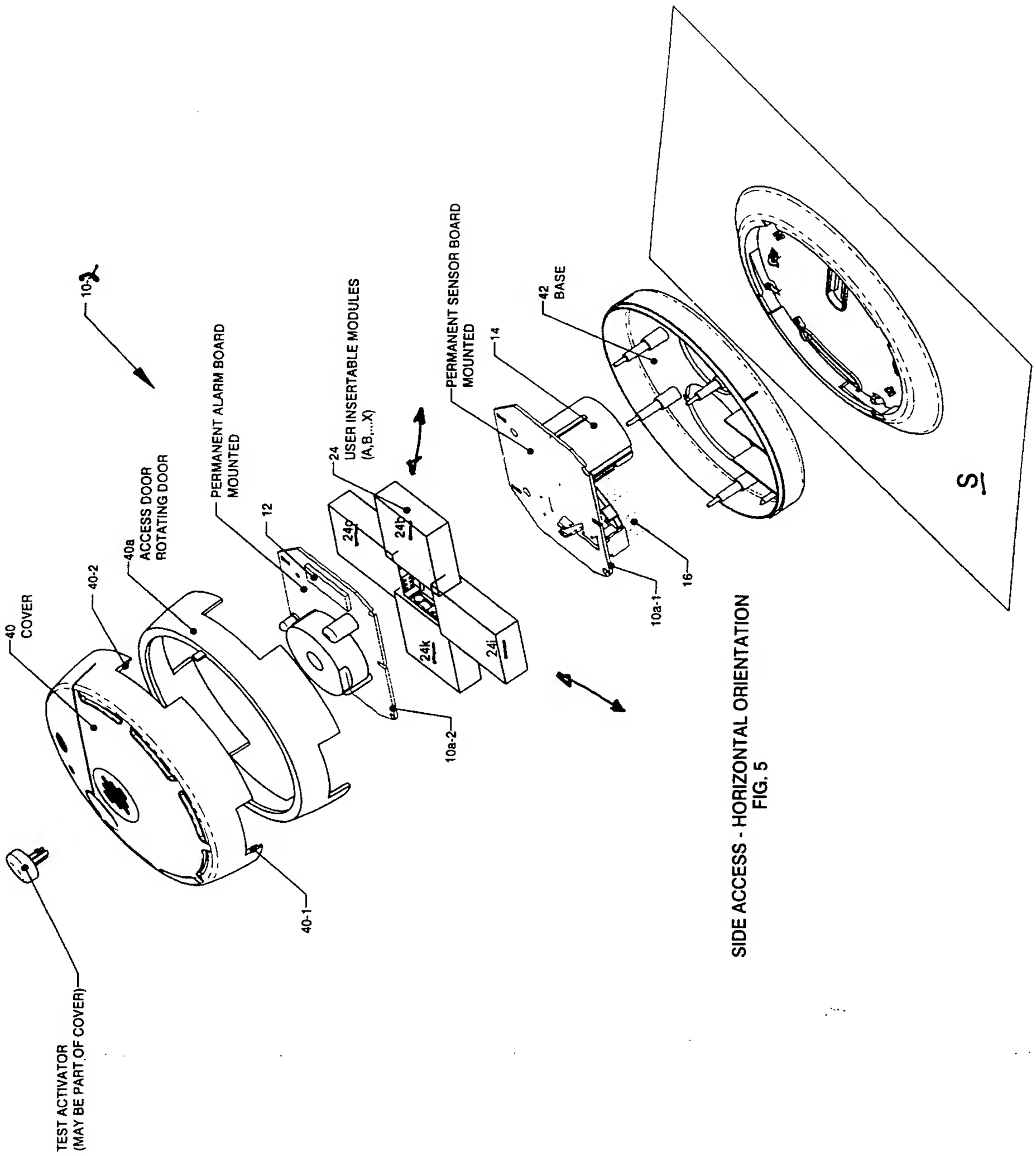

TOP ACCESS - VERTICAL ORIENTATION
TEST ACTIVATOR (MAY BE PART OF COVER)
30a DOOR TO ACCESS MODULES
24 USER MODULES (A,B,...X)
24b
24c
24l
30 COVER
30-3
30-2
30c
30-1
12
PERMANENT ALARM BOARD MOUNTED
PERMANENT SENSOR BOARD MOUNTED
19
10a-2
14
30b BASE
10a-1
16
32
33 MOUNTING BRACKET
S

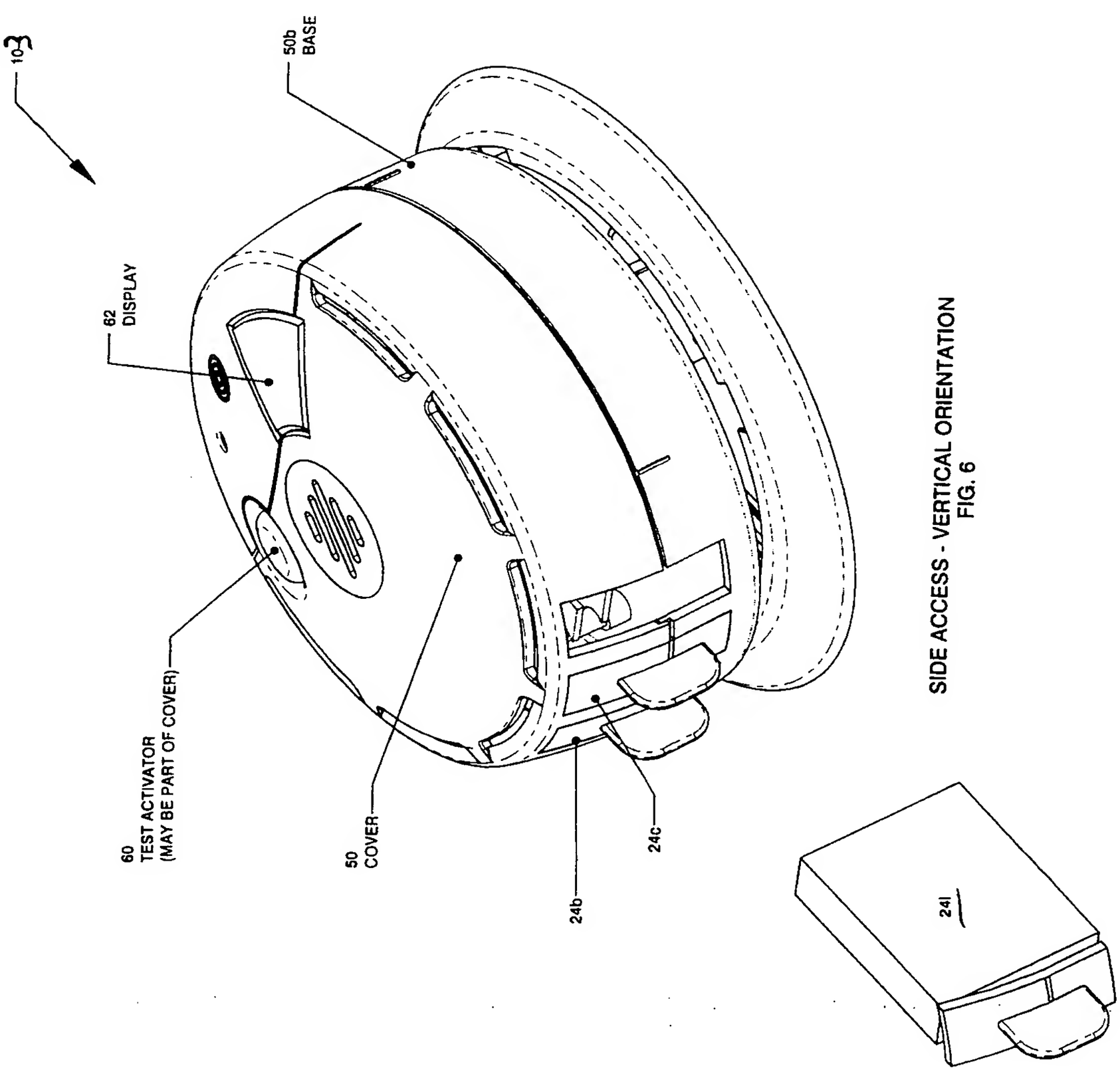
FIG. 3



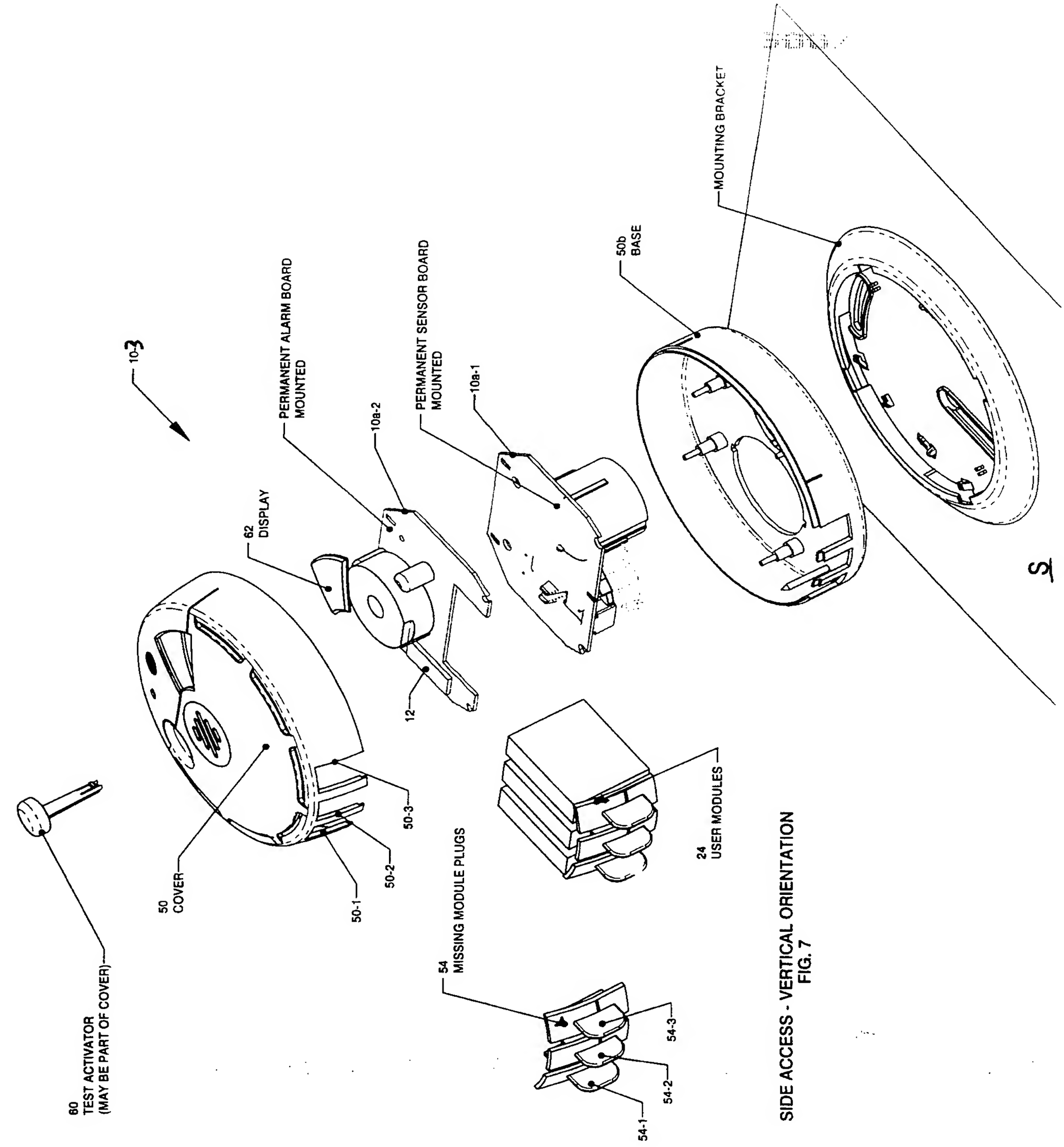
SIDE ACCESS - HORIZONTAL ORIENTATION
FIG. 4



SIDE ACCESS - HORIZONTAL ORIENTATION
FIG. 5



SIDE ACCESS - VERTICAL ORIENTATION
FIG. 6



SIDE ACCESS - VERTICAL ORIENTATION
FIG. 7